UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April/Mei 2006

EPD 422/3 – Rekabentuk Sistem Pembuatan

Masa : 3 jam

ARAHAN KEPADA CALON :

Sila pastikan bahawa kertas soalan ini mengandungi **SEMBILAN (9)** mukasurat dan **ENAM (6)** soalan serta **SATU (1)** lampiran yang bercetak sebelum anda memulakan peperiksaan.

Sila jawab **LIMA (5)** soalan sahaja.

BAHAGIAN A

Mengandungi **TIGA (3)** soalan Kajian Kes dan Calon Wajib menjawab **SEMUA** soalan.

BAHAGIAN B

Mengandungi **TIGA (3)** soalan dan Calon dikehendaki menjawab hanya **DUA (2)** soalan sahaja.

Lampiran A : Carta Aliran Process/*Process Flow Diagram*
[Sila pastikan **LAMPIRAN A** diikat bersama-sama dengan kertas jawapan anda]

Calon dibenarkan menjawab semua soalan dalam **Bahasa Inggeris** ATAU **Bahasa Malaysia** ATAU kombinasi kedua-duanya.

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

...2/-

Bahagian A *(Section A)*: Sila jawab SEMUA soalan pada Bahagian ini.

Sila baca fakta kajian kes dengan teliti dan kemudian jawab semua soalan dalam bahagian ini. Pastikan anda menjawab soalan secara berturutan.

ALPHA SDN. BHD. OPERATION ANALYSIS REPORT

1.0. BACKGROUND

ALPHA Sdn. Bhd. is a manufacturer of a plastic injection mould. The demand of plastics product/components had increase tremendously. Because of that ALPHA had to do overtime and out-sourcing to meet the order. Based on the report from Marketing/Sales department the demand for plastic products will continuously increase. They intend to improve their capacity and operation efficiency. The improvement was necessary to ensure the company is competitive in the market.

2.0. OBJECTIVES

- *To reduce the lead time*
- *To increase the throughput*
- *To reduce work in progress (WIP) inventory*
- *To improve labour technique*
- *To reduce the labour cost*

3.0. CURRENT OPERATION

ALPHA runs only one (1) shift per day (9 hours/shift) for 5 days a week (20 days per month). Productive hours available per shift is 8 hours excluding 1 hour lunch break. Labour cost is RM10.00 per hour and overtime rate is RM30.00 per hour.

ALPHA adopts a flexible shift system, where each section can commence job/work at any shift that is applicable to the section needs on a working day. ALPHA is divided into 6 department as shown in the Table 1 below;

SECTION	*EQUIPMENT*	*WORKFORCE*
Warehouse	*5 manual lifter pallet truck*	*5 workers*
Mill Section	*5 semi-auto milling machines*	*5 machinists*
EDM Section	*5 electrical discharge machines*	*5 machinists*
Drill Section	*5 semi-auto drilling machines*	*5 machinists*
Polish Section	*5 semi-auto buffer machines*	*5 machinists*
QC Section	*5 manual metrology instrument*	*5 technicians*

Table 1: ALPHA Production Facility & Capacity

...3/-

The Warehouse stored the standard block of tool steel for mould production process. Raw material request is in a form of batches. The raw material will be charged out upon request by any of the production sections as per listed in the Table 1. Raw materials are sent to the section that request for the material by warehouse workers using a manual lifter pallet truck. The pallet can contain 1 batch (equivalent 10 unit) of standard tool steel block.

*The current plant layout of the machine operation section for **ALPHA** production line is shown in Figure 1. At each processing sections, there is a intermediate storage area to store the raw material received from the warehouse, WIP parts and finished goods. The intermediate storage area can accommodate only 1 batch of parts. WIP parts can only be transferred to the next operation by request of the succeeding/subsequent operation. The movement of raw materials, WIP parts and finished goods must be in the form of batch.*

Warehouse Section	*Mill Section*	*EDM Section*	*Drill Section*	*Polish Section*	*QC Section*

*Figure 1: **ALPHA** Plant Layout*

4.0. OBSERVATION OF OPERATION

a) Plastic injection mould production requires various processing stages based on the design of the mould. There are two most common demand of plastic injection mould i.e. polished mould and unpolished mould that is utilised in certain group of machining operation with a very specific sequence.

*b) **ALPHA** production schedulling adopts a simple dispatching rule where the first job to arrive at any particulars section will be processed first without any delay. Another dispatching rule is that the job will be sent to the machine that is nearest and first available at the production section.*

c) Average mould manufacturing output per week is 50 unit. Overtime is required in order to complete all the 50 units within one week.

d) Based from the time study;

- *Average time for 1 batch to be transferred from one section to another section using the manual lifter truck is 10 minutes.*
- *All machine operation requires an average of 60 minutes of machining process per mould except for EDM machining where it requires 2 hours of machining time.*
- *Set-up time, which include loading and unloading of mould from pallet to the machine and vice versa is 30 minute per mould for all machining operation including EDM.*
- *Quality Control (QC) section requires an average of 30 minutes to conduct inspection for each mould.*

e) High WIP and bottlenecking occurs at various section especially EDM Section because of the lengthy machining time. Limited space for intermediate storage of parts had worsen the situation.

d) The situation higlighted in (e) creates high machine and workforce idle time which is a waste of resources.

...4/-

UNTUK TUJUAN PENGIRAAN SAHAJA : Semua pengiraan mesti mengambil kira masa untuk pergerakkan/pemindahan palet dan sila anggap tiada produk yang terbuang atau produk rosak yakni "Kecacatan Sifar". Jika anda membuat sebarang andaian untuk sesuatu pengiraan yang dibuat, SILA NYATAKAN DENGAN JELAS mengapa andaian tersebut penting.

FOR CALCULATION PURPOSE ONLY : All calculation must include the moving/transferring time of the pallet and assume there are no product waste or reject product i.e. "Zero Defect". If you make assumption for any given calculation, PLEASE STATE CLEARLY why the assumption is important.

Anda telah dilantik untuk mewakili Jabatan Pembuatan untuk membuat analisa secara terperinci lalu mengenalpasti sistem pembuatan yang optima. Maka sebagai seorang jurutera pembuatan, tugas anda adalah untuk menerangkan dan menjawab semua persoalan tentang rekabentuk sistem pembuatan seperti yang disenaraikan dibawah.

You are appointed as one of the team members to represent the Manufacturing Department to carry out the detail analysis and identifying the best solution to achieve the optimal manufacturing system design. Thus as a manufacturing engineer, your task will involve in explaining and clarifying all the questions related to the manufacturing system design, which is listed below.

S1. [a] Berdasarkan maklumat kajian kes;
Based from the information of the case study;

i) **Senaraikan LIMA (5) data-data penting yang diperlukan untuk tujuan pengiraan.**

List FIVE (5) important data that can be used for calculation purposes.

ii) **Apakah jenis sistem pengeluaran yang digunakan?**

What type of production system is used?

iii) **Namakan *'dispatching rule'* yang diaplikasikan untuk penjadualan menjadualkan pengeluaran.**

Name the 'dispatching rule' that was applied for the production scheduling.

iv) **Pada pendapat anda mengapa *'dispatching rule'* "mesin terhampir dan pertama" digunakan?**

Based on your opinion why is the 'dispatching rule' "nearest and first available machine" was adopted?

(50 Markah)

...5/-

[b] **Terang secara ringkas LIMA (5) cadangan/langkah umum untuk mengatasi masalah yang dihadapi oleh ALPHA ketika ini?**

Explain briefly FIVE (5) general proposals/steps to overcome the problem currently faced by ALPHA.

(50 Markah)

S2. [a] **Berpandukan Jadual S2[a] dan menggunakan kaedah carta "Daripada-Kepada" :**

Refering to Table Q2[a] and using the "From-To" chart method :

i) **Tentukan susunan terbaik seksyen mesin untuk talian pengeluaran ALPHA**

Determine the best arrangement of machine section for ALPHA production line.

TO / FROM	Mill	EDM	Drill	Polish
Mill	0	1	0	3
EDM	0	0	0	1
Drill	4	1	0	0
Polish	0	1	0	0

Jadual S2[a]: Penjadualan Pengeluaran Bulanan
Table Q2[a]: Monthly Production Scheduling

(ii) **Terdapat dua jenis acuan yang paling banyak menerima tempahan sebagaimana yang telah dinyatakan di dalam laporan "ALPHA Operation Analysis". Guna susunan seksyen mesin yang diperolehi daripada S2[a](i) dan Jadual S2[a], bina carta "Analisa Aliran Produk" *(PFA)* untuk mengenal pasti jumlah kuantiti setiap jenis acuan tersebut.**

There are two types of mould polished and unpolished received the highest order as mentioned in the "ALPHA Operation Analysis" report. Use the arrangement of machine section from Q2[a](i) and Table Q2[a] to construct the "Product Flow Analysis" (PFA) chart in order to identify the total quantity for each type of moulds.

(40 Markah)

...6/-

[b] (i) **Daripada "Analisa Aliran Produk" *(PFA)* yang diperolehi daripada S2[a](ii), lengkapkan "Carta Aliran Proses" (Lampiran A) untuk menghasilkan satu kelompok acuan yang digilap dan masukkan masa setiap aktiviti.**

From the "Process Flow Analysis" (PFA) of Q2[a](ii), complete the attached "Flow Process Chart"(Appendix A) to produce one batch of polished mould and insert the timing for each activities.

(ii) **Kirakan jumlah masa mendulu pengeluaran bagi menyiapkan semua pesanan acuan jenis digilap dan tidak digilap berdasarkan ("Analisa Aliran Produk" *(PFA)* yang diperolehi daripada S2[a](ii) dengan mengambil kira kekangan situasi operasi ketika ini (rujuk laporan). Anggap kedua-dua pesanan acuan tersebut diterima secara serentak.**

(Sila gunakan kertas graf yang disediakan dan kepilkan kertas graf bersama-sama dengan skrip jawapan).

Calculate the total production lead time needed to completed the order polished and unpolished mould based from the PFA of Q2[a](ii) with respect to the current operation constraints (refer to the report). Assumed the orders, for both mould, are received at the same time.

(Please use the graph paper provided and attach the graf paper with answer script)

(60 Markah)

S3. Pihak pengurusan ALPHA Sdn. Bhd. telah memperuntukkan bajet sebanyak RM450,000.00 untuk Projek Peningkatan Produktiviti (PIP). Berikut adalah cadangan yang telah dikemukakan:

- **Membeli Pemesinan Sepusat CNC yang boleh menggabungkan fungsi mesin separa automatik pengisar, pengerudi dan pengilap. Keupayaan automasi Pemesinan Sepusat CNC dapat mengurangkan kitaran masa pengeluaran kepada 10 minit untuk satu komponen. Masa "set-up" untuk mesin tersebut dikurangkan kepada 5 minit. Kos Pemesinan Sepusat CNC termasuk pemasangan dianggarkan sekitar RM177,000.00 seunit.**

- **Penggunaan peralatan automasi metrologi yang dihubungkan ke Pemesinan Sepusat CNC akan melupuskan keperluan aktiviti pemeriksaan acuan oleh Juruteknik QC. Kos peralatan tersebut bernilai RM37,000.00 seunit termasuk perisian yang boleh dihubungkan kepada pengawal CNC.**

...7/-

*The management of **ALPHA** Sdn. Bhd. had allocated a budget of RM450,000.00 for Productivity Improvement Project (PIP). Following is the proposal to be considered:*

- *Buying CNC Machining Center can combined function of the semi-automatic milling, drilling and polishing. The automation capability of the CNC Machining Center can reduce the machining time to 10 minutes per component. The set-up time is reduced to 5 minute. The cost of the CNC Machining Center including commissioning is estimated at RM177,000.00 per unit.*
- *Using an automated metrology equipment attached to the CNC Machining Center will discard the requirement for the QC technician to do the mould inspection activity. The equipment cost is RM37,000.00 per unit including the software that can link the CNC controller to the metrology equipment.*

Lakukan satu kajian kebolehlaksanaan untuk mendapatkan maklumat seperti berikut:

Conduct a feasibility study to acquire the following information:

[a] Jumlah unit Pemesinan Sepusat CNC dilengkapi dengan peralatan pemeriksaan automatik yang boleh dibeli dalam lingkungan bajet tersebut.

Total unit of the CNC Machining Center equipped with automated inspection system that can be purchased within the approved budget.

(30 Markah)

[b] Berapakah jumlah keseluruhan penjimatan kos buruh yang boleh diperolehi berdasarkan pembelian mesin seperti dalam soalan S3[a].

What is the total labour amount of labour cost saved when machine purchase is made as per question Q3[a].

(40 Markah)

[c] Dapatkan tempoh pulangan modal pelaburan.

Find payback period of the investment.

(30 Markah)

...8/-

Bahagian B *(Section B)*:

Sila jawab DUA (2) soalan sahaja.

S4. [a] Merujuk kepada kajian kes, seandainya pihak pengurusan memutuskan untuk menyusun semula susunatur syarikat, bagaimanakah kamu dapat mengklasifikasikan aktiviti-aktiviti yang akan dilakukan berdasarkan masalah susunatur?

Referring to the case study, suppose the management decided to reconfigure the company's layout, how would you classify the activities that would be carried out on the basis of layout problem?

(20 Markah)

[b] Pihak pengurusan memutuskan menggunakan kaedah "Systematic Layout Planning" (SLP) untuk menukar susunatur sedia ada.

The management would like to use the Systematic Layout Planning (SLP) method for reconfiguring their existing layout.

(i) Apakah elemen-elemen asas setiap masalah susunatur yang didefinasikan oleh kaedah SLP?

What are the basic elements of every layout problem that is defined by the SLP method?

(20 Markah)

(ii) Bincangkan hubung-kait elemen-elemen yang disenaraikan dalam soalan S4[b](i) dengan perancangan susunatur.

Discuss the relation between elements listed in question Q4[b](i) with layout planning.

(60 Markah)

...9/-

S5. Jabatan Penyelidikan dan Pembangunan syarikat telah mengusulkan untuk memperkenalkan beberapa rangkaian produk baru. Susunatur sedia ada tidak berupaya menampung peningkatan kadar pengeluaran baru jika rangkaian itu diperkenalkan. Satu pasukan dibentuk bagi merekabentuk satu susunatur baru di lantai pengeluaran. Kamu sebagai jurutera pembuatan telah dipertanggungjawabkan untuk mengetuai pasukan untuk merekabentuk dan memasang susunatur baru tersebut.

The company's R&D department is proposing to introduce a new range of products. The existing shop floor is unable to cope with the new production rate if it introduced. A team is assigned to design and install a new layout on the shop floor. You as a manufacturing engineer have been given a responsibility to lead the team to design and install the new layout.

(i) Senaraikan LIMA (5) faktor yang boleh mempengaruhi bentuk aliran susunatur yang akan direka.

List the LIVE (5) factors that may affect the flow pattern of the layout that is being designed

(20 Markah)

(ii) Senarai dan bincangkan secara terperinci maklumat yang diperlukan untuk merekabentuk satu susunatur yang baru berdasarkan analisis aliran.

List and discuss in detail the information that you require in order to design properly the new layout based on the flow analysis.

(80 Markah)

S6. Apabila merekabentuk satu susunatur, halangan boleh berlaku dalam bentuk struktur bangunan sedia ada, had saiz bangunan dan kekurangan wang bagi pembinaan bangunan baru, oleh itu anda tidak hanya mengambil kira keperluan ruang tetapi juga luas ruang yang sedia ada.

When designing a layout, constraints can be in the form of an existing building structure, a limitation on the size of building or the availability of capital for new construction, therefore you are not only considering the space requirement but the space available as well.

(i) Bincangkan secara ringkas kepentingan untuk tidak hanya mengambil kira keperluan ruang tetapi juga luas ruang yang sedia ada.

Discuss briefly the importance of not only considering the space requirement but also the space available.

(30 Markah)

(ii) Senaraikan dan bincangkan secara terperinci LIMA (5) cara asas untuk menentukan keperluan ruang dalam susunatur yang akan direka.

List and discuss in detail the basic FIVE (5) ways in which to determine the space requirements of the layout that being to designed.

(70 Markah)

-oooOOOooo-

LAMPIRAN A: Carta Alir Proses
APPENDIX A: Process Flow Diagram

Activity	Flow Chart Symbol					Qty	Est. Time (min)	Additional Info
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			
	○	⇨	□	D	▽			

[1/1]